Journal of Advances in Medicine and Medical Research

32(24): 364-372, 2020; Article no.JAMMR.66820
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Viral Hepatitis Training for Laboratory Workers: Addressing the Unaddressed

Pranav Keshan[1], Sapna Chauhan[1], Sabin Syed[1], Aayushi Rastogi[2] and Akanksha Bansal[3*]

[1]Project ECHO and PRAKASH, Institute of Liver and Biliary Sciences, New Delhi, India.
[2]Department of Epidemiology, Institute of Liver and Biliary Sciences, New Delhi, India.
[3]Project ECHO, PRAKASH & LEAD, Institute of Liver and Biliary Sciences, New Delhi, India.

Authors' contributions

This work was carried out in collaboration among all authors. Authors AB and SC conceived and planned the study. Authors AB, SC and PK carried out the study. Author SC worked out almost all of the technical details. Author PK performed the data analysis for the data collected. Authors PK and AR contributed to the interpretation of the results. Author PK took the lead in writing the manuscript. All authors provided critical feedback and helped to shape the research, analysis and manuscript. Author AB supervised the implementation of overall project. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2020/v32i2430852
Editor(s):
(1) Dr. Ashish Anand, University of Mississippi Medical Center, USA and William Carey School of Osteopathic Medicine, USA.
Reviewers:
(1) Maung Maung Mya, Myanmar.
(2) Christulas Jyoti, Sankalchand Patel University, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/66820

Original Research Article

Received 26 October 2020
Accepted 28 December 2020
Published 31 December 2020

ABSTRACT

Aims: The aim of the study was to assess the current Knowledge, Attitude and Practice (KAP) of laboratory technicians about viral hepatitis and to assess the effect of one day training on knowledge levels of the participants.
Study Design: Pre-post design.
Place and Duration of Study: Institute of Liver and Biliary Sciences New Delhi and October 2018 to September 2019.
Methodology: A one-day training program titled "Hepatitis Induction Program" on viral hepatitis for laboratory technicians was conducted. The participants were provided theoretical as well as demonstrative and hands-on training about diagnostic management and prevention of viral

**Corresponding author: E-mail: akankshambansal@gmail.com;*

hepatitis among laboratory technicians. An online link for KAP and Pre-post knowledge assessment questionnaire consisting 49 (KAP) questions was shared with all registered participants. Same knowledge questionnaire consisting 25 questions was shared with the participants after training. One mark was allotted for each correct response. The data was analysed using IBM-SPSS version-21. Independent samples t-test was used to assess the mean knowledge score across various demographic factors and the paired t-test was used to assess the improvement in knowledge post training. Pearson correlation coefficient was used to establish relationship between KAP score. The statistical significance was considered at 0.05.

Results: A total of 151 laboratory technicians were trained in 5 one day trainings and data for KAP and pre-post assessment data was available for all 151 participants. Correlation coefficient between knowledge, attitude and practice score stated a positive correlation between knowledge and attitude (r=0.36 *P*<0.001), knowledge and practice (r=0.192, *P*<0.001), attitude and practice (r=0.425, *P*<0.001). Also, Mean difference between pre and post knowledge score was 3.12 which was statistically significant (*P*<0.001).There was no significant association observed between pre-post knowledge score and demographic characteristics.

Conclusion: The study was able to reflect the significant effect of one-day training regarding diagnostic management and prevention of viral hepatitis on knowledge level of the laboratory workers. The present training program can also be up scaled and help in educating the lab technicians on various health-related topics across the country as authors have found lack of studies or training programs of this kind for the laboratory workers.

Keywords: Laboratory workers; viral hepatitis; prevention; management; infection.

1. INTRODUCTION

Laboratory workers are predominantly exposed to a wide array of biological, chemical and physical occupational hazards and majorly several microbial infections such as Hepatitis viruses, Human Immunosuppressant Virus (HIV), *Mycobacterium tuberculosi*s and several others [1,2]. A study stated that almost two-third of the laboratory workers are exposed to at least one type of biological hazard, most commonly being virus, bacteria and parasites while working in laboratory [2]. Viral hepatitis being one of the most severe infection which is acquired by laboratory technicians while processing samples from liver disease patients such as liver cirrhosis and hepato-cellular carcinoma [3]. Further, the risk associated with viral hepatitis infection may not be seen immediately, due to its asymptomatic nature for a longer period of time [4].

In the health care setting, transmission of blood-borne pathogen transmission occurs predominantly by percutaneous or mucosal exposure of laboratory technicians to the blood or body fluids of infected patients [5]. Another form of transmission is through occupational hazards such as needle stick injuries (NSI) or injuries from sharp and small instruments or non-availing of post exposure prophylaxis [6,7]. It arises primarily due to the way laboratory workers handle the routine laboratory activities and despite the precautions taken by the workers in the laboratory [8]. Few studies estimated that the risk of Hepatitis B virus (HBV) transmission among healthcare workers ranges from 6% to 30% while for Hepatitis C virus (HCV) rate of transmission was reported to be 1.8% [9]. Also, the risk of exposure tends to increase due to (i) non-availability of safety measures such as bio-safety cabinets, safety manuals, safety kits and (ii) ignorance of good lab practices [10,11].

Apart from this, knowledge and awareness about occupational hazards and precautionary measures plays the most important role in minimising the risk of associated infections [11,12]. The lack of awareness regarding biosafety, leads to inappropriate handling of infectious samples and hazardous laboratory practices during sample collection, processing, and discarding of specimens. These unsafe laboratory practices potentially result in increased exposure to pathogens among laboratory technicians [13]. However, familiarity and use of universal precautions while handling blood and bodily fluid as well as other contagious samples can help in reducing the exposure to pathogens in laboratory settings [13]. Further, some studies have reported poor to moderate knowledge about occupational health and safety among laboratory technicians [14,15].

Moving forward, poor knowledge can be enhanced by providing trainings and educating

the laboratory staff on good laboratory practices on a regular basis [16]. Also, occupational hazards can be reduced through theoretical as well as hands-on training of laboratory technicians [17]. With this vision, one day training program of laboratory technicians titled "Hepatitis Induction Program" was conducted under project PRAKASH (PRogrammed Approach to Knowledge And Sensitization on Hepatitis). The primary objective of the program was to educate and impart theoretical as well as hands-on training about overview of viral hepatitis, serological and molecular methods of testing, good lab practices, rapid card tests, ELISA and CLIA among laboratory technicians. The aim of the study was to assess the current Knowledge, Attitude and Practice (KAP) of laboratory technicians about viral hepatitis and to assess the effect of one day training on knowledge levels of the participants.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A pre-post study design was undertaken among the laboratory staff working in healthcare facilities across India from October 2018 to September 2019. This study was undertaken among the participants of one-day training program on viral hepatitis for laboratory technicians, titled "Hepatitis Induction Program" organised under project PRAKASH, at Institute of Liver and Biliary Sciences (ILBS).

2.2 Study Population

The laboratory staff working in healthcare facilities who registered for Hepatitis Induction Program under project PRAKASH were eligible for the study. The participants who completed the pre and post assessment were included in the study. The participants who didn't complete the training or didn't undertake the pre or/and post-test assessment were excluded from the study.

2.3 Study Tool

A KAP questionnaire with four sections consisting of 49 questions was circulated with the participants. Section A collected demographic details whereas section B, C and D had questions related to Knowledge (25 questions), Attitude (12 questions) and Practice (12 questions) respectively. Knowledge questions were further divided into five domains based on diagnostic management and prevention of viral hepatitis. The five domains of knowledge section were: (i) General awareness (ii) Transmission and Risk factors (iii) Diagnosis and Lab Practices (iv) Prevention and (v) Bio-safety. General awareness domains consisted of five questions: Q1, Q3, Q6,Q10 and Q21 with total of five marks, transmission and risk factors domain had four questions: Q2, Q8, Q15, Q24 and had total of four marks. Further, diagnosis and lab practices domain had maximum seven questions, which were Q4, Q5, Q7, Q9, Q12, Q17 and Q18 with maximum marks totalling to seven whereas prevention and bio-safety domains had five and four questions respectively of five and four marks. Prevention domain had Q11, Q20, Q22, Q23, Q25 and bio-safety had Q13, Q14, Q16 and Q19. For every correct response, one mark each was assigned in knowledge question, while attitude questions were on likert scale of one to five (where five was strongly agree, one was strongly disagree and vice versa for negative questions). Practice question had responses yes, no and don't know with marking as two for yes, one for don't know and zero for no.

3. METHODOLOGY

A one-day training program titled Hepatitis Induction Program was conducted under project PRAKASH, ILBS from October 2018 to September 2019 on viral hepatitis for laboratory technicians. The primary objective of the training was to educate and impart theoretical as well as demonstrative and hands-on training about diagnostic management and prevention of viral hepatitis among laboratory technicians.

The scientific agenda of the training program was finalised in consultation with faculty members of Department of Virology at ILBS. Subsequently, speakers were finalised and study material was prepared by the project team. Based on the study objectives, the Department of Virology prepared KAP and Post assessment questionnaires for laboratory technicians. The study materials were shared with the subject matter experts for review and were finalised after incorporating changes suggested by them. Post which registration for the training program was started, there was provision of both online as well as offline mode for registration of the participants.

Before, commencement of the training program, an online KAP questionnaire on diagnostic management of viral hepatitis was circulated among the participants through SurveyMonkey

platform. The link for online KAP questionnaire was shared with the laboratory technicians on their registered email ID and mobile numbers. Post KAP assessment, the training on scientific sessions on diagnostic management and prevention of viral hepatitis was deliberated by the subject matter experts through face to face medium. The training program was scheduled for the whole day starting from 10.00 a.m. to 5.00 p.m. The training program was divided into two halves, first half was for theoretical scientific sessions and second half was assigned for hands-on and demonstration. Theoretical scientific sessions were delivered into three major themes of one hour each. The three themes were: (i) Introduction and overview of viral hepatitis (ii) Laboratory diagnosis of viral hepatitis and (iii) Bio-safety in laboratory. At the end of each session, queries of the participants were taken and addressed by the subject experts. Hands-on and demonstrative sessions were conducted by senior residents and laboratory workers at ILBS for enhancement of practical knowledge levels on Rapid card tests, ELISA, CLIA and other diagnosis. At the end of theoretical as well as hands-on and demonstrative sessions, post knowledge assessment and feedback on overall and session-wise training was conducted among laboratory workers using the online link. The link was shared through same channel as used for KAP assessment. Post assessment questionnaire consisted of same questions as in knowledge section in KAP assessment. For feedback, participants were asked to rate overall and session wise training on likert scale of one to five, where one being least meaningful and five being most meaningful.

3.1 Data Management and Statistical Analysis

The data for KAP and Post knowledge assessment, feedback were extracted in MS-Excel from SurveyMonkey and was analysed using IBM-SPSS version 21.0. The continuous data was presented as mean and standard deviation (SD) or median and interquartile range (IQR) while categorical data was summarized as frequencies with percentages. For the purpose of analysis, the age was categorised into two categories as less than 35 years and 35 years and above [18]. The experience was divided into two categories (i) less than 5 years and (ii) 5 years and above [19]. Similarly, knowledge score was divided as poor-to-moderate (<75%) and good (≥75%) [20, 21]. Independent t-test was used to assess the association between the mean knowledge score and various demographic variables. The paired t-test was used to assess the overall and domain wise mean difference in pre and post knowledge assessment amongst the participants. Pearson correlation coefficient was used to establish relationship between KAP score. The level of significance was taken as <0.05.

4. RESULTS AND DISCUSSION

4.1 RESULTS

A total of five training were conducted for laboratory workers under project PRAKASH at ILBS. A total of 151 laboratory technicians were trained and data for KAP and pre-post assessment data was available for all 151 participants. However, participation in the study was completely voluntary and online informed consent was duly taken from the participants before participation in the study.

The mean age of the participants who attended the training was 33.18±8.75 years and their median years of experience were 7 (IQR: 2.5-14.0). Approximately 55% of the participants were males and around 61.8% of the participants were having experience of 5 years and above. The mean knowledge, attitude and practice score were recorded to be 17.76±3.71, 44.81±7.00 and 18.45±3.83 out of total score of 25, 12 and 12 respectively. Pearson correlation coefficient between knowledge, attitude and practice score stated a positive correlation between knowledge and attitude (r=0.36 P<0.001), knowledge and practice (r=0.192, P<0.001), attitude and practice (r=0.425, P<0.001).

The mean knowledge score in pre and post assessment was found to be 17.76±3.71 and 20.88±2.59 out of total score of 25. Mean difference between pre and post knowledge score was 3.12 which was statistically significant (P<0.001). Further domain wise mean pre knowledge scores were 3.62±0.97 out of 5 in general awareness, 2.86±0.96 out of 4 in transmission and risk factors domain, 4.62±1.53 out of 7 in diagnosis and lab practices whereas in prevention and biosafety domains, mean score were 3.72±1.15 and 3.28±0.97 out of total 5 and 4 respectively. Post training mean knowledge scores for all the domains have shown an increment and all these increment were found to be statistically significant (P<0.001) (Table 1).

Table 1. Total and domain wise Pre-post knowledge assessment

Domain Name	Mean Pre- assessment score (SD)	Mean Post assessment score (SD)	*P*-value
General Awareness	3.62±0.97	4.38±0.68	<0.001
Transmission and Risk factors	2.86±0.96	3.10±0.83	<0.001
Diagnosis and Lab Practices	4.62±1.53	5.64±1.16	<0.001
Prevention	3.72±1.15	4.17±0.99	<0.001
Biosafety	3.28±0.97	3.60±0.61	<0.001
Overall Knowledge Score	17.76±3.71	20.88±2.59	<0.001

**SD: Standard Deviation*

It was found that around 52% of the participants were having poor to moderate knowledge in the pre-assessment whereas 15% of the participants had poor to moderate knowledge after attending one day training program. The percentages of correct responses in the pre and post assessment of knowledge were approximately 73% (ranging from 23% to 99%) and 84% (ranging from 48% to 99%) respectively. Approximately 77% of the laboratory workers were aware about type of viruses, whereas 71% knew the type of virus transmitted through contaminated food and water while 74% of the participants were aware about transmission mode of hepatitis B virus. Further, merely 23% of the totals were aware about satellite virus linked with hepatitis B virus. Approximately half of the respondent had knowledge regarding secondary antibody in sandwich ELISA. Around 93% of the participants were familiar with risk of blood borne viruses associated with NSI, however merely 64% knew the process being followed post NSI. Around 93% of the laboratory workers had correct knowledge on meaning of Polymerase Chain Reaction (PCR) but less than 50% knew the correct sequence of steps performed in PCR. Good lab practices were understood in 70% of the laboratory technicians, whereas number of biosafety levels was recalled by lower proportion (52%) (Supplementary Table 1).

There was no significant association observed between pre-post knowledge score and demographic characteristics (age, gender and experience), indicating there was no difference in knowledge levels of the laboratory workers with respect to their demographic characteristics (Table 2).

Table 3. demonstrates the overall and session wise feedback of the participants, which indicates overall mean feedback score of 38.42±5.21 out of total of 45, the score stated a favourable response on acceptance and effectiveness of one-day training program in laboratory technicians. Further, maximum mean feedback score of 4.41±0.66 was recorded for good lab practices and quality control session, while minimum mean feedback score of 4.09±0.87 was observed in molecular methods in viral hepatitis testing session.

4.2 Discussion

Laboratory technicians are one of the most important as well as vulnerable group with respect to appropriate diagnosis, management of hepatitis and risk of getting infected due to occupational hazards during their routine work. Despite their vulnerability to viral hepatitis, less attention is given to universal precautions which can actually prevent the infection. With this objective, a one-day training program was designed among laboratory workers under the umbrella ship of Project PRAKASH in collaboration with Department of Virology to impart theoretical and hands-on training on diagnosis, management and prevention of viral hepatitis. The present study aimed to assess the current KAP of laboratory technicians about viral hepatitis and also assessed the effect of one day training on their knowledge levels.

The mean pre knowledge was found to be 17.76±3.71 with 52% lying in poor to moderate category which was in line with the studies conducted from developing countries [22, 23]. Similar findings from a Nigerian study demonstrated severe deficiencies in the knowledge, attitudes and practice of laboratory safety by laboratory staff with respect to use of personal protective equipment, specimen collection and processing, centrifuge--related hazards, infective hazards and waste disposal [23]. Approximately 71% of the participants knew about the transmission of the virus which was found to be similar in a past study (66.7%) from India [24]. The findings of our study re-emphasised that approximately less than two-third knew the process to be followed after

needle stick injuries (NSI) [25]. In addition to this, knowledge related to biosafety (approximately 70%) was in congruence with another study from India [26].

A majority of the participants (96%) mentioned that they reported use of gloves during phlebotomy processes; 99% suggested they were using sterile syringes for these processes. These findings are in line with the present study as compared with an earlier study [25]. Despite the safe and effective hepatitis B vaccine, the effectiveness of the vaccine is less likely to be recognised in the study participants (41%) which is similar to a study from South Kivu [27]. Further, a high percentage of the laboratory technicians have reported to be screened for HBV and HCV and around 90% of the participants have reported to be vaccinated against the HBV. The findings of the study are found to be higher as compared to another study from Delhi [28]. This could be attributable to the fact that the participants in our study belonged to various centres across Delhi where immunization practices could be different whereas previous study was undertaken in a single tertiary care hospital. The one-day training indicated a significant increase in knowledge levels of the participants as reported by already existing studies on paramedical staff [29].

As per our existing knowledge, this is one a kind study from India that has conducted the KAP about viral hepatitis among the laboratory technicians and also assessed the effect of one-day training the knowledge level of the participants However, there could have been a selection bias in participants who have filled the KAP questionnaire as the participation in the study was voluntary. The study could have also suffered a response-shift bias because of its default pre-post design [30]. The study observed exceptionally high attitude and practice scores with poor to moderate knowledge score which could be an indication of social desirability response. Further, no formal sample size calculation was done for the study.

Despite these inherent limitations, this is one of the unique studies that have trained a wide range of laboratory workers across the country. Moreover, the study was able to assess

Table 2. Association of pre and post knowledge assessment with demographic characteristics

Demographic variables	Mean Pre Test Score (SD)	*P*-value	Mean Post Test Score (SD)	*P*-value
Age				
< 35 years	17.73±3.92	0.97	20.98±2.60	0.59
≥ 35 years	17.75±3.44		20.75±2.62	
Gender				
Male	18.23±3.74	0.08	21.06±2.51	0.34
Female	17.19±3.61		20.66±2.69	
Experience				
Less than 5 years	17.73±4.17	0.92	21.00±2.48	0.47
5 years and above	17.66±3.44		20.67±2.71	

**SD: Standard Deviation*

Table 3. Overall and session wise feedback on training program

Session Name	Mean Score±SD
Overview of Viral Hepatitis (A-E)	4.24±0.78
Serological methods Viral Hepatitis testing	4.19±0.74
Molecular methods in Viral Hepatitis testing	4.09±0.87
Good lab practices and quality control	4.41±0.66
NSI and Post Exposure Prophylaxis	4.39±0.69
Rapid card tests – Hands on live demonstration experience	4.35±0.92
ELISA – Hands on live demonstration and experience	4.29±0.86
CLIA - Hands on live demonstration and experience	4.26±0.89
Micropipetting techniques and calibration - Hands on live demonstration and experience	4.35±0.87
Overall feedback score	38.42±5.21

**SD: Standard Deviation*

the effect of one-day training regarding diagnostic management and prevention of viral hepatitis on knowledge level of the laboratory workers. Overall, study observed significant improvement of knowledge among laboratory workers which can be attributable to one-day training program. However, more studies are required to study the factors associated with learning and training in future. The present training program can also be up scaled and help in educating the lab technicians on various health-related topics across the country as authors have found lack of studies or training programs of this kind for the laboratory workers.

The study recommends a larger study with sample size calculation to be undertaken in laboratory workers. The participants can be followed up for a certain time period to assess the effect of training on knowledge, attitude and practice.

5. CONCLUSION

The study was able to assess the effect of one-day training regarding diagnostic management and prevention of viral hepatitis on knowledge level of the laboratory workers. Overall, study observed significant improvement of knowledge among laboratory workers following one-day training program. However, more studies are required to study the factors associated with learning and training in future. The present training program can also be up scaled and help in educating the lab technicians on various health-related topics across the country as authors have found lack of studies or training programs of this kind for the laboratory workers.

CONSENT

Participation in the study was completely voluntary and online informed consent was duly taken from the participants before participation in the study.

ETHICAL APPROVAL

The present activity was undertaken as a part of outreach activity; however, ethical clearance was obtained with No. F.37/(1)/9/ILBS/DOA/2020/20217/78 dated 01-03-2021 from the institutional ethics committee.

ACKNOWLEDGEMENTS

The authors sincerely acknowledge Cipla Foundation, for their financial grant provided to Project PRAKASH, However, there is no conflict of interest or financial ties to disclose. Authors also express their gratitude to Dr. S.K.Sarin, Director Institute of Liver and Biliary Sciences for providing his mentorship. Authors also extend their thanks to all the faculties and speakers, for their continuous support to the project.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Zaveri J, Karia J. Knowledge, Attitudes and Practice of Laboratory Technicians Regarding Universal Work Precaution. 2012;2(1):3.
2. Tait FN, Mburu C, Gikunju J. Occupational safety and health status of medical laboratories in Kajiado County, Kenya. Pan Afr Med J. 2018;29:65.
3. Balogh J, Victor D, Asham EH, Burroughs SG, Boktour M, Saharia A, et al. Hepatocellular carcinoma: A review. J Hepatocell Carcinoma 2016;3:41-53.
4. Wiktor SZ. Viral Hepatitis. In: Holmes KK, Bertozzi S, Bloom BR, Jha P, editors. Major Infectious Diseases. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017
[cited 2021 Jan 22].
Available:http://www.ncbi.nlm.nih.gov/books/NBK525186/
5. Singhal V, Bora D, Singh S. Hepatitis B in Health Care Workers: Indian Scenario. J Lab Physicians. 2009;1(2):41–8.
6. De Carli G, Abiteboul D, Puro V. The importance of implementing safe sharps practices in the laboratory setting in Europe. Biochem Medica. 2014;24(1):45-56.
7. Sheth SP, Leuva AC, Mannari JG. Post exposure prophylaxis for occupational exposures to HIV and Hepatitis B: Our experience of thirteen years at a rural based tertiary care teaching hospital of Western India. J Clin Diagn Res JCDR 2016;10(8):39-44.
8. Sewunet T, Kebede W, Wondafrash B, Workalemau B, Abebe G. Survey of safety practices among hospital laboratories in Oromia Regional State, Ethiopia. Ethiop J Health Sci 2014;24(4):307-10.

9. Beltrami EM, Williams IT, Shapiro CN, Chamberland ME. Risk and management of blood-borne infections in Health Care Workers. Clin Microbiol Rev. 2000;13(3):385-407.
10. Jena GB, Chavan S. Implementation of Good Laboratory Practices (GLP) in basic scientific research: Translating the concept beyond regulatory compliance. Regul Toxicol Pharmacol RTP 2017;89:20-5.
11. Sewunet T, Kebede W, Wondafrash B, Workalemau B, Abebe G. Survey of safety practices among hospital laboratories in Oromia Regional State, Ethiopia. Ethiop J Health Sci. 2014;24(4): 307–10.
12. Shekhar H, Patel M, Jain C, Garg N, Mangukiya K. Awareness to health hazards and biosafety precautions among laboratory technicians working in tertiary-care center in Rajasthan, India. Int J Med Sci Public Health. 2015;4(1):15-8.
13. Peng H, Bilal M, Iqbal HMN. Improved Biosafety and Biosecurity Measures and/or Strategies to Tackle Laboratory-Acquired Infections and Related Risks. Int J Environ Res Public Health; 2018.
[cited 2021 Jan 22];15(12).
Available:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6313313/
14. Alzahrani K. Assessment of biosafety and associated Occupational hazards among laboratories health workers in Governmental Moderate and High Complexity Medical Labs (Jeddah, 2018). Undefined; 2018.
[cited 2021 Jan 22];
Available:/paper/Assessment-of-Biosafety-and-associated-Occupational-Alzahrani/91c97a2d04ee49d499073063ca7691fb8e7d3303
15. Odetokun IA, Jagun Jubril AT, Onoja BA, Wungak YS, Raufu IA, Chen JC. Status of laboratory biosafety and biosecurity in veterinary research facilities in Nigeria. Saf Health Work 2017;8(1):49-58.
16. Goswami HM, Soni ST, Patel SM, Patel MK. [Pdf] A Study on Knowledge, Attitude and Practice of Laboratory Safety Measures Among Paramedical Staff of Laboratory Services | Semantic Scholar.
[cited 2021 Jan 22];
Available:https://www.semanticscholar.org/paper/A-STUDY-ON-KNOWLEDGE%2C-ATTITUDE-AND-PRACTICE-OF-OF-Goswami-Soni/4fae4134e92fbd13aaf529679cdbc26f1e229530
17. O'connor T, Flynn M, Weinstock D, Zanoni J. Occupational Safety and Health Education and Training for Underserved Populations. New Solut J Environ Occup Health Policy NS 2014;24(1):83-106.
18. Abolfotouh MA, AlQarni AA, Al Ghamdi SM, Salam M, Al Assiri MH, Balkhy HH. An assessment of the level of concern among hospital-based health-care workers regarding MERS outbreaks in Saudi Arabia. BMC Infect Dis. 2017;17(1):4.
19. Shindano TA, Bahizire E, Fiasse R, Horsmans Y. Knowledge, attitudes, and practices of health-care workers about viral Hepatitis B and C in South Kivu. Am J Trop Med Hyg; 2017;96(2):400-4.
[cited 2021 Jan 29];.
Available:https://www.ajtmh.org/view/journals/tpmd/96/2/article-p400.xml
20. Berhea TA, Belachew AB, Abreha GF. Knowledge and practice of Essential Newborn Care among postnatal mothers in Mekelle City, North Ethiopia: A population-based survey. PLOS ONE. 2018;13(8): e0202542.
21. Chavan GM, Waghachavare VB, Gore AD, Chavan VM, Dhobale RV, Dhumale GB. Knowledge about diabetes and relationship between compliance to the management among the diabetic patients from Rural Area of Sangli District, Maharashtra, India. J Fam Med Prim Care 2015;4(3): 439–43.
22. Zaveri J. Knowledge, attitudes and practice of laboratory technicians regarding universal work precaution -. Natl J Med Res; 2012;2(1):113-5.[cited 2021 Jan 29];.
Available:https://www.bibliomed.org/?mno=18734
23. Ejilemele AA, Ojule AC. Knowledge, attitude and practice of aspects of laboratory safety in Pathology Laboratories at the University of Port Harcourt Teaching Hospital, Nigeria. Niger J Clin Pract. 2005;8(2):102–6.
24. Koria B, Lala MK. A study of knowledge, attitude and practice of Hepatitis-B infection among the laboratory technicians in the civil hospital, Ahmedabad, Gujarat. Healthline. 2012;3(1).
Available:http://www.healthlinejournal.org/index_pdf/16.pdf
25. Maurya MK. Knowledge, awareness and practices regarding sharp injuries among

health care workers of pathology lab in a tertiary care hospital. J Diagn Pathol Oncol. 2017;2(2):20–5.

26. Keshan P, Rastogi A, Aggarwal S, Nigam A, Kapila R, Syed S. Effect of one-day training on Knowledge related to Biosafety and waste management among life-science Students. Indian J Community Health. 2020;32(4).
[cited 2021 Jan 30];
Available:https://www.iapsmupuk.org/journal/index.php/IJCH/article/view/1943

27. Shindano TA, Bahizire E, Fiasse R, Horsmans Y. Knowledge, Attitudes, and Practices of Health-Care Workers About Viral Hepatitis B and C in South Kivu. Am J Trop Med Hyg. 2017;96(2):400-4.
[cited 2021 Jan 30];
Available:https://www.ajtmh.org/view/journals/tpmd/96/2/article-p400.xml

28. Jha AK, Chadha S, Bhalla P, Saini S. Hepatitis B Infection in Microbiology Laboratory Workers: Prevalence, Vaccination, and Immunity Status. Hepat. Res. Treat. 2012;2012:e520362
[cited 2021 Jan 30];
Available:https://www.hindawi.com/journals/heprt/2012/520362/

29. Holodnick CL, Barkauskas V. Reducing percutaneous injuries in the OR by educational methods. AORN J. 2000;72(3): 461–4, 468–72, 475–6.

30. Howard GS. Response-shift bias: A Problem in Evaluating Interventions with Pre/Post Self-Reports. Eval Rev. 1980; 4(1):93–106.
[cited 2021 Jan 18];
DOI:https://doi.org/10.1177/0193841X8000400105

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/66820